THE ROLE OF CULTURE IN EARLY EXPANSIONS OF HUMANS

Editorial

In this 20th newsletter, ROCEEH takes you on a little trip around the world. We tell the story of stone technologies in southern Italy at the transition from Middle to Upper Paleolithic, the paleoenvironment of *Homo erectus* in Indonesia, and a unique eyed needle from the Armenian Highlands. We hope you enjoy!

Technological behavior of the last Neanderthal and first Sapiens in Italy

Tools and technology at the Middle to Upper Paleolithic transition

Stone tools represent material traces of past behaviors and bear witness to our most ancient past. These artifacts not only preserve information about their final form, but also inform us about the way people produced them. Moreover, by reconstructing the process of production–which archaeologists call the reduction sequence–we gain insights into the most complex and intriguing part of our distant past: the cognitive capacities of our ancient relatives.

A crucial point in our evolutionary history occurred when tools and technology started to allow *Homo sapiens* (also known as anatomically modern humans) to adapt to and spread into different environments, and thereby outperform the other species of hominins who inhabited our planet in the past. In prehistoric archaeology, the transition between the Middle and Upper Paleolithic occurred approximately 50,000-40,000 years ago. This period represents a crucial stage in human prehistory because it corresponds to the demise of the Neanderthals and the dispersal of *Homo sapiens* across the world, as humans established themselves as a global species.

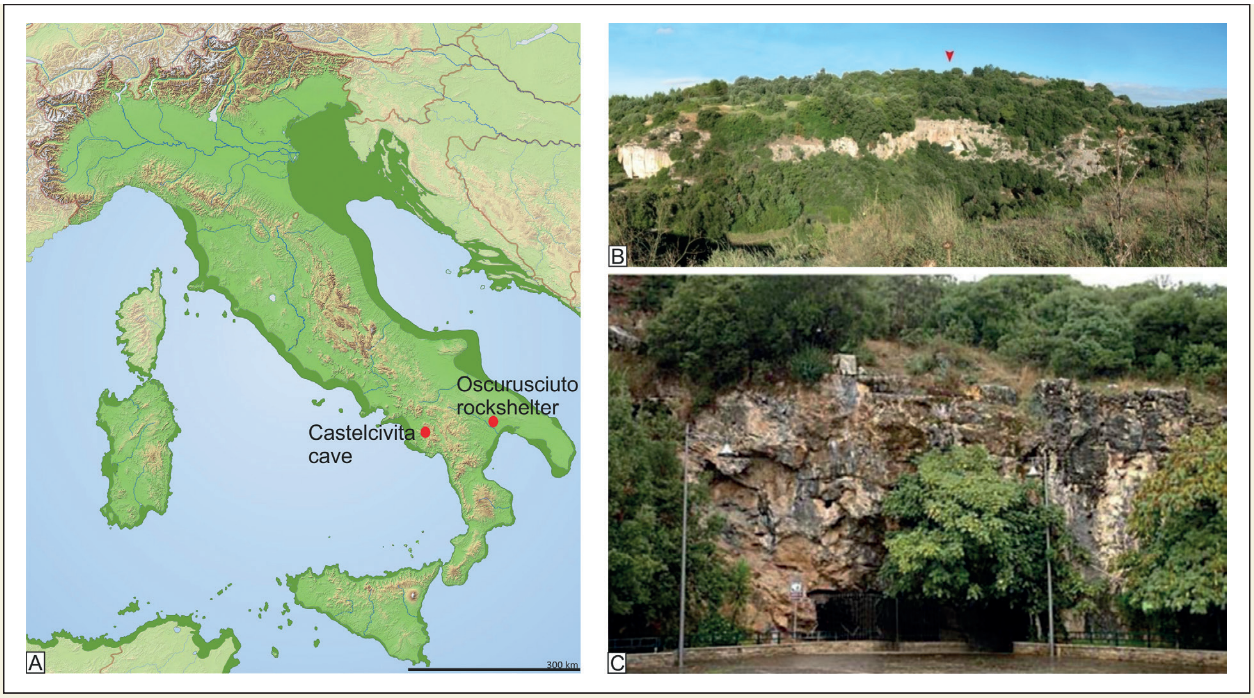
One of the main objectives of the ERC-SUCCESS project, of which I am part, is to study the bio-cultural, adaptive, and ecological characteristics that make our species successful and unique. My objectives are to understand the role that technology played, and directly compare the technological behaviors related to the production of stone tools made by the two different species (Neanderthals and Sapiens) at some key sites in Italy.

Cognigrams of the tool behavior of the last Neanderthals and first Sapiens in Italy

Directly comparing datasets is the greatest challenge in the study of stone artifacts. Information collected from different contexts and influenced by different approaches of study results in diverse sets of data, which are sometimes impossible to compare. Another challenge is how to compare activities such as flaking procedures related to the production of stone tools. To meet these challenges, we need to establish an architectural framework that allows a comparison on both large temporal and geographical scales, as well as between different behaviors and species. The ROCEEH research center has addressed such challenges for more than a decade. As a visiting researcher, I worked with the ROCEEH team, especially Miriam Haidle and Andrew Kandel, to learn about cognigrams and the ROAD database.

The aims of my visit were twofold. First, I wanted to evaluate the expression of tool behavior from an organizational and cognitive point of view by applying the meta-tool of cognigrams to the archaeological toolkit of the last Neanderthals and the first modern humans of the Italian peninsula. Second, I wanted to learn about the structure and potentials of the ROAD database. My month at the ROCEEH center gave me the unique opportunity to learn about cognigrams and the ROAD database and discuss their applications in the place where these tools were developed.

Cognigrams are a flowchart used to code and compare different behavioural performances. Miriam Haidle developed them in 2005 as a method of reverse engineering. Since then, researchers have used cognigrams effectively in cognitive archaeology for well over a decade as tools to ‘think-through’ technologies.



▲ Figure 1. A) Map with location of the key sites (modified after Moroni et al. 2018). B) The ravine of Ginosa and Oscurusciuto rockshelter (modified after Marciani et al. 2020). C) The cave of Castelcivita (modified after Arrighi et al. 2020). The Research Unit Prehistory and Anthropology of the University of Siena carried out research at Oscurusciuto and Castelcivita.

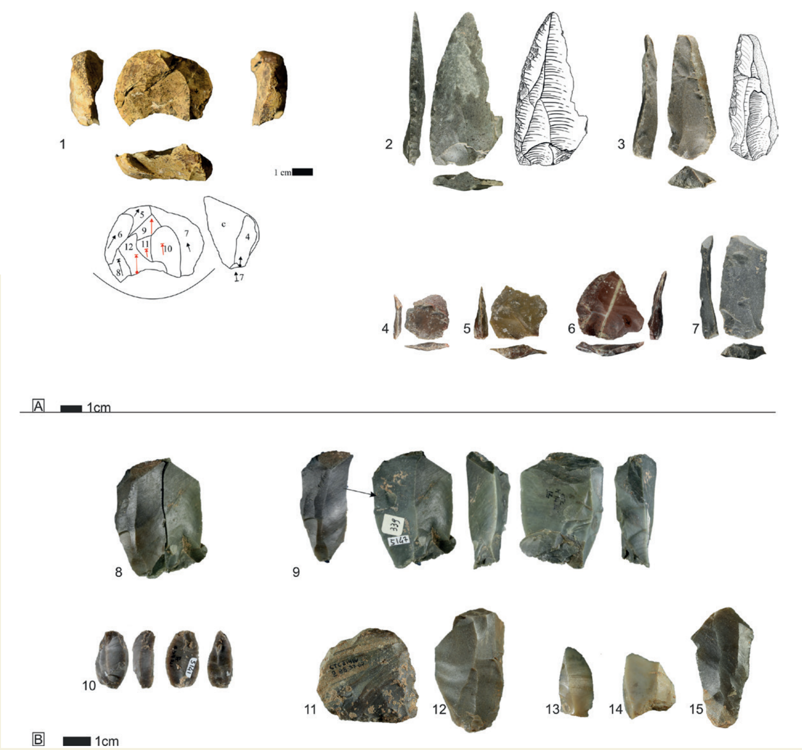
They allow us to compare activities from different contexts and actors, using perception-and-action sequences for tool behavior, and provide a contextualized scheme of the developmental procedure. This makes them a valuable meta-tool to standardize and compare the degree of complexity related to different activities coming from different contexts and performed by different species.

Cognigrams allows us to approach technical behavior with a different and innovative perspective. The focus moves from the stone tool to the actions of the knapper, meaning the decisions made behind the technical procedure of flaking. In my project, I was interested in directly comparing and understanding the similarities and differences related to the production of stone tools. I examined two key sites for the Middle to Upper Paleolithic transition in Italy: Oscurusciuto and Castelcivita, both located in southern Italy (Fig. 1A). Specifically, I wanted to encode through the cognigrams the behavioral architectures of the Levallois reduction sequence at the Mousterian site of Oscurusciuto (Fig. 1B) (considered to be made by Neanderthals) and of the Uluzzian reduction sequence of the cave of Castelcivita (Fig. 1C) (considered to be made by Sapiens). By encoding these two behaviors in a comparative framework, I wanted to gain a better understanding of the two modes of technology and their relative complexity. I created cognigrams on each module of the reduction sequences for both assemblages. This process considered the acquisition of raw material, core reduction, anvil procurement and preparation. I compared and described the cognigrams related to each module of the reduction sequences and the final diagram at both sites, in order to understand the two ways of perceiving technology.

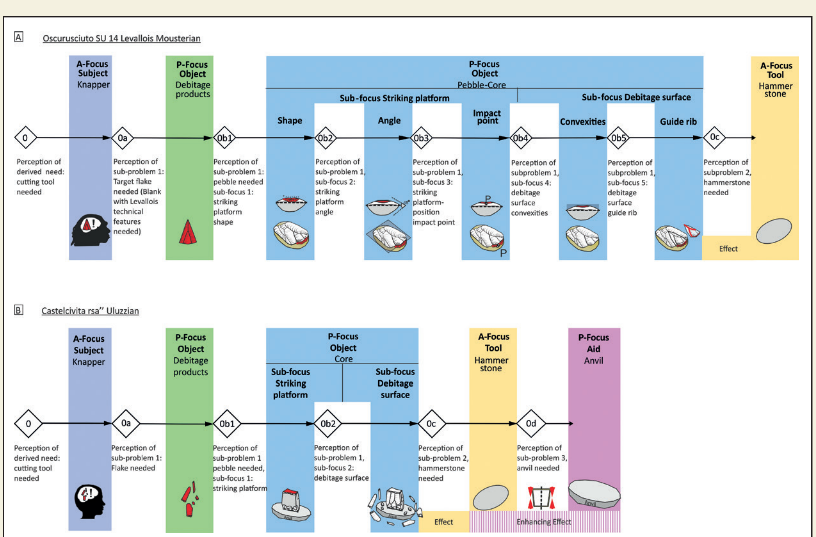
The first site, Oscurusciuto rock shelter, is characterized by a rich Mousterian sequence, and the occupation level selected is called SU 14. This stratigraphic unit represents a short-term occupation within a layer of tephra (volcanic ash) called the Green Tuff of Mount Epomeo (Ischia) dated to 55,000 years before present. Production in this layer is characterized first by the local procurement of raw materials in the form of pebbles. Core reduction is represented mainly by the Levallois concept (Fig. 2A). A feature of Oscurusciuto is that Neanderthals selected pebbles which already possessed the convexities suited to the extraction of Levallois target objects. In other words, we see a careful choice starting already with the acquisition of raw material. To obtain target objects with predetermined traits, Neanderthals applied the Levallois method, which is a mode of production that requires the control of several factors (sub-foci) during reduction. These factors may include the shape of the striking platform, the angle, the point of impact, the convexities of the debitage surface, and the guiding ridge (Fig. 3A). Consequently, by paying greater attention to the management of the core, Neanderthals could pursue a wide variety of standardized target objects. The retouched tools are mainly scrapers made on Levallois blanks or cortical flakes, suggesting that Neanderthals selected the waste of debitage to retouch.

The second site, Castelcivita, is a cave which preserves evidence of an important cultural sequence, encompassing Late Mousterian, Uluzzian, and Protoaurignacian stone industries. In the Uluzzian lithic assemblage of the layer rsa", knappers selected angular blocks and fragments as raw material. The debitage is characterized by a low degree of preparation of lateral and distal convexities and reflects mainly a unidirectional mode of flaking which exploits one, two, or more debitage surfaces. The debitage is much simpler when compared to the Levallois at Oscurusciuto. The desired target objects are less standardized, and consequently require less control. Core reduction was achieved mainly through the bipolar technique on anvil, which permits the production of several target objects in an easier and faster way (Figs. 2B and 3B). At Castelcivita some unstandardized flakes and even fragments were selected for retouch. Certain classes of retouched tools were used for specific uses: end scrapers for hide processing, and lunates to arm projectile weapons.

If we compare only the cognigrams related to the module of core reduction, it is clear that the Levallois at Oscurusciuto is much more complex than the Uluzzian reduction sequence. This is based on the degree of predetermination of the target objects. More standardized Levallois objectives require a higher degree of attention in core management. Thus, we observe the opening of several sub-foci in the cognigrams (Fig. 3A).



◀ Figure 2. A) Mousterian lithic materials from Oscurusciuto SU 14 (modified after Marciani et al. 2020): (1) convergent Levallois core; (2-3) side scrapers; Levallois debitage products; (4-5) flakes; (6) convergent flake; (7) blade. B) Uluzzian lithic materials from Castelcivita rsa'': (8-9) refitting set of a bipolar core and a blade; (10) bipolar core; (11-12) end scrapers; debitage products: (13-14) flakes; (15) blade. Photos (8-15): Giulia Marciani.



◀ Figure 3. Simplified scheme of the cognigrams: A) Production of Levallois convergent flake in the Mousterian from Oscurusciuto SU 14. B) Production of an unstandardized flake using bipolar technique on anvil in the Uluzzian from Castelcivita rsa". Graphic: Giulia Marciani.

On the other hand, in the Uluzzian, the module of core reduction is much simpler because the objectives are less standardized, implying a less managed reduction (Fig. 3B).

However, the production of lithic tools reflects only one module of the entire technological behavior of this group. By comparing the entire technological system at each site (Fig. 4), we note several modules related to the production of complementary tools and projectile weapons in the Uluzzian. These interpretations are also based on the evidence from other Uluzzian sites, e.g., Grotta del Cavallo. Activities such as hafting, gluing, and fletching are present at Castelcivita but absent at Oscurusciuto. These modules can be broken up into several cognigrams related to the realization of each component and the way they come together. This more nuanced view adds a greater degree of complexity to the entire technological system of the site. While the Uluzzian tool-making of Sapiens seems more straightforward than the Neanderthal choice, the entire architecture in which it developed is much more complex. Specifically, it requires the combination of several components and incremental growth of modules, actions, and intricacy. The application of cognigrams allows us to explore the lithic technological data further, so that we obtain a novel perspective on the technological behavior. We become aware how stone artifacts produced by Neanderthals and Sapiens are differently embedded within the broader context of planning, actions, and decisions. This consequently allows further insights into the different aspects of the relationship between humans and technology which occurred in the past, regardless of whether the humans were Neanderthals or Sapiens.

Using the ROAD Database to disentangle the Middle to Upper Paleolithic transition

In order to frame the technological evidence of the Mousterian of Oscurusciuto and the Uluzzian of Castelcivita, and other Italian sites, in the broader and complex context of the Middle to Upper Paleolithic transition in Eurasia, I made use of the ROAD database. To make this comparative analysis, I needed access to a significant amount of organized and standardized chronological, stratigraphical, and contextual data from a wide geographical and chronological scale, especially with reference to lithic assemblages. Using this information, I further plan to address the theme of technology during the Middle to Upper Paleolithic transition. I want to search for similarities and dissimilarities in lithic production, and assess whether the rise of new technical ideas results from dispersion and interaction between populations, or rather, independent parallel innovation. Finally, I plan to tackle the possible role that technology played to give *Homo sapiens* an advantage, which could have directly or indirectly caused the extinction of the Neanderthals.

Giulia Marciani

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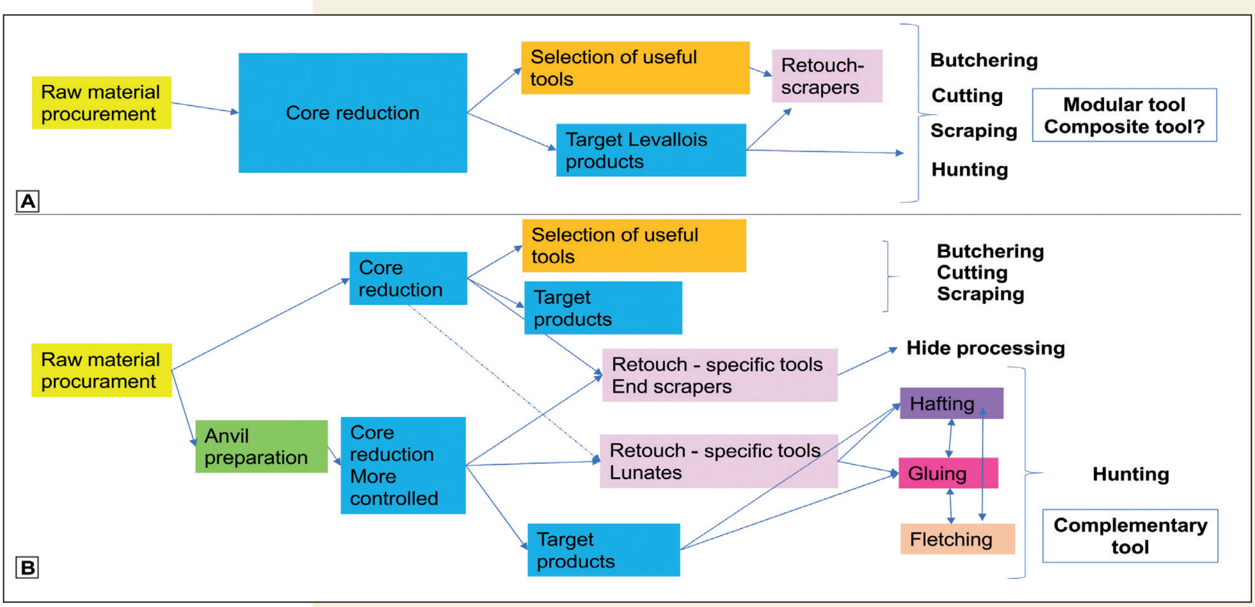

▲ Figure 4. Modular scheme of the Mousterian from Oscurusciuto SU 14 and the Uluzzian from Castelcivita rsa''. Graphic: Giulia Marciani.

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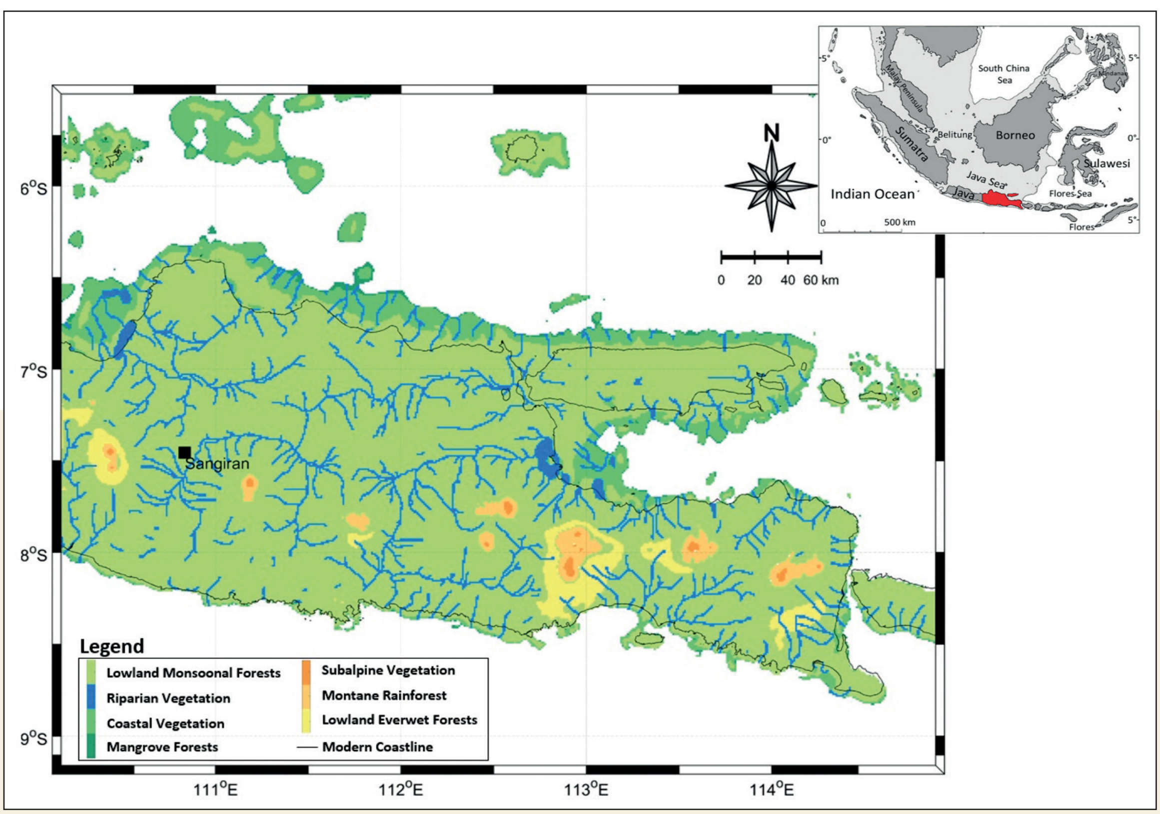
Living in Sangiran one million years ago

Hominins in Sangiran, Central Java, have been known since the early 20th century. The locality provides the most extensive record of Early to Middle Pleistocene hominins in Southeast Asia, with the chronological distribution covering at least 600,000 years of the history of early human occupation. Unlike other localities, Sangiran provides an almost continuous record of lithological sections without major interruptions. An enormous quantity and diversity of paleontological and archaeological discoveries found in continuous stratigraphic layers allow for various interpretations of changes in the surrounding environment, hominin morphology, and technology applied by *Homo erectus*. However, how *Homo erectus* lived and interacted with the respective environment is still an open question. Of course, we cannot directly observe their daily activities or examine their strategies to adapt to changes in the environment.

This project was funded within the framework of the von Koenigswald research fellowship at the Senckenberg, funded jointly by the Reimers Foundation, the Daimler Foundation, and the Johanna Quandt Foundation. Our goal was to reconstruct the paleoenvironment and resource base of *Homo erectus* in Sangiran. Using Agent-Based Modeling (ABM), we also attempted to identify the ways in which they managed to survive and supply themselves with food, freshwater, and other resources. The time about one million years ago is particularly suitable for this study for two main reasons. First, *Homo erectus* was firmly settled in Java at that point in time. Moreover, this time corresponds to the Grenzbank zone in the lithological



▲ Figure 5. Map of paleovegetation covering eastern Java at 1 Ma. Each vegetation unit was defined by elevation (as the result of paleotopographic reconstruction), drought category (based on paleoclimatic reconstruction) and/or other geomorphologic features such as rivers and lakes. Maps: Mika Puspaningrum et al. forthcoming.